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The future of the CDM: same same, but differentiated?

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Abstract

Policymakers and scientists have raised concerns about the functioning of the Clean Development Mechanism (CDM), in particular regarding its low contribution to sustainable development, unbalanced regional and sectoral distribution of projects, and its limited contribution to global emission reductions. Differentiation between countries or project types has been proposed as a possible way forward to address these problems. The present article provides an overview of the different ways in which CDM differentiation could be operationalised. It analyses their implications for the actors involved in the CDM and provides a quantitative assessment of the impacts on the carbon market, using bottom-up marginal abatement cost curves. The article concludes that the discounting of CDM credits, quota systems or differentiated eligibility of countries could help to address several of the concerns raised. Preferential treatment may also make a limited contribution to achieving the aims of CDM differentiation by increasing opportunities for underrepresented host countries. The impact on the carbon market appears to be limited for most options.

Keywords

Carbon market; Clean Development Mechanism; discounting; differentiation; Kyoto Protocol

1. Introduction

The Clean Development Mechanism (CDM) has two main goals: cost-effective compliance with the Kyoto Protocol for developed (Annex B) countries through greenhouse gas emission reductions in developing (non-Annex B) countries, and contributing to sustainable development in non-Annex B countries (Article 12.2 Kyoto Protocol). With the expiry of the first commitment period of the Kyoto Protocol in 2012 drawing closer, there are now various discussions on the future design of the CDM (UNFCCC, 2009a). At the same time, other instruments to enhance climate change mitigation in developing countries, such as sectoral mechanisms and nationally appropriate migration actions (NAMAs) are also being considered in the broader negotiations on a post-2012 climate policy framework, including the Copenhagen Accord (UNFCCC, 2009b; 2009c), implying that the role of the CDM in the future may be subject to change.

The discussions on the CDM focus on options for reforming the mechanism, and for addressing various concerns about its functioning such as its limited environmental effectiveness, sustainable development contribution and skewed regional distribution (Bakker et al., 2009). In this context, several options for differentiation in the CDM have been proposed by policymakers and academics. Differentiation can be defined as the application of different rules to CDM projects taking place under different circumstances, with the objective to compensate for market imperfections or for less desired outcomes. This article examines two types of differentiation options in particular: 1) differentiation between countries; and 2) differentiation between project types. It assesses the impacts of differentiation on the carbon market and on CDM governance and the project cycle. Finally, it discusses the extent to which differentiation options may address the concerns raised about the CDM.

Section 2 briefly describes the most recurrent criticisms on the CDM. Section 3 provides a brief overview and typology of options for differentiation as they have been proposed in the literature. Section 4 presents a qualitative and quantitative analysis of the impacts of CDM differentiation on the carbon market, while section 5 discusses the governance implications of the various options. Section 6 examines the potential of CDM differentiation to address the various concerns. Finally, section 7 presents the main conclusions and recommendations.

2. Concerns about the functioning of the CDM

Policy circles as well as the academic literature have pointed to various shortcomings in the current functioning of the CDM. First, it has been noted that the CDM does not lead to global emission reductions but is at best a mechanism that offsets emission increases in Annex B countries (Chung, 2007; Schneider, 2009). In fact, the CDM may even contribute to a rise in global emissions, as many project activities have difficulty demonstrating additionality, i.e. they may have happened even without the mechanism (Michaelowa and Purohit, 2007; Schneider, 2007), but the credits they generate are still used for compliance purposes by Annex B countries. Second, the contribution of the CDM to sustainable development in the host countries is widely seen as very limited (Holm Olsen, 2007; Sutter and Parreño, 2007; cf. Gupta et al., 2008). Third, Asian and Latin American countries make up more than 95% of the projects and certified emission reductions (CERs) in the CDM project pipeline (UNEP/Risø, 2010), raising concerns about the equitable regional and sub-regional distribution of projects (UNFCCC, 2008a; see also Cosbey et al., 2006; Van Asselt and Gupta, 2009). Fourth, the unequal distribution of CDM projects among sectors has also been noted, with the transport and building sectors, both key for achieving ambitious climate targets, virtually absent from the project portfolio (Zegras, 2007; Schneider, 2009). Fifth, certain project types, notably the destruction of industrial gases such as HFC-23 and N_2O, are thought to generate high windfall profits for project developers and host countries (Schatz, 2008; Wara and Victor, 2008). Finally, projects face significant transaction costs due to the institutional and governance structure of the CDM (Streck and Lin, 2008; Boyle et al., 2009).

3. Options for differentiation in the CDM

To some extent, the current rules governing the CDM already incorporate elements of differentiation, such as the exemption of least-developed countries (LDCs) from CDM levies, the application of simplified procedures for small-scale projects, and the exclusion of certain project types (e.g. nuclear). Second, following a decision taken at the fifth Meeting of the Parties to the Kyoto Protocol in Copenhagen, the CDM Executive Board may prioritise baseline and monitoring methodologies for underrepresented sectors, simplify methodologies for small-scale renewables and energy efficiency projects, and develop top-down methodologies and allocate resources to cover project cycle cost for countries hosting fewer than 10 registered projects (UNFCCC, 2009d).

In addition, differentiation can be implemented in the buyer's market. This can have a significant effect, particularly given the current concentration in the market, with for instance the European Union accounting for over 80% of the CER demand in 2008 (Capoor and Ambrosi, 2009). There is already differentiation in the buyer's market to some extent, in particular regarding the sustainable development contribution of CDM projects, with the

CDM Gold Standard as a prime example.[1] Furthermore, existing and planned emissions trading systems include possibilities to differentiate. In the first phases of the European emissions trading scheme, specific project types were excluded (e.g. land use, land use change and forestry) or could only be approved if certain conditions were fulfilled (e.g. large hydropower projects).[2] In the United States, several legislative proposals for federal cap-and-trade schemes have included the possibility to differentiate between emission credits. For instance, two key bills in the US Senate in 2009 – Kerry-Boxer and Waxman-Markey – both suggest differentiating between offsets generated internationally and domestic offsets.[3] Notwithstanding these unilateral approaches towards differentiation, our focus here is on differentiation options at the international level, an issue that has generated extensive debate in the past few years.

A range of options for further differentiation within the CDM in a future climate regime has been proposed in policy discussions in the UNFCCC context and in the literature. Table 1 provides a brief overview of these options.[4] A key distinction is made between the object of differentiation, namely countries and project types.

<insert Table 1>

Differentiation between countries could be implemented on the basis of individual countries or country groupings (e.g. LDCs). Furthermore, it could be done in an ad hoc manner, or more systematically by using specific criteria such as income or emissions per capita in a country (for an overview of possible criteria, see Karousakis et al., 2008). Likewise, differentiation between project types could single out specific project types, or could be based on more general criteria against which all project types are evaluated (e.g. projects' contributions to sustainable development).

The options for differentiation listed above are not mutually exclusive. Some of them clearly overlap, and a range of combinations is (theoretically) possible. For instance, certain host countries could either become ineligible to host CDM projects in general, or ineligible only to

[1] Renewable energy and energy efficiency can undergo screening for their sustainability impacts in addition to the usual CDM project cycle, in order to be certified as CDM Gold Standard projects.

[2] Articles 11a and 11b of Directive 2003/87/EC, as amended by Directive 2004/101/EC. The condition for large hydropower projects is that projects need to be in line with the World Commission on Dams' recommendations on large dams. The latest revision of Directive 2003/87/EC (through Directive 2009/29/EC) does not exclude any specific project type, but states that it is possible to restrict the use of credits from certain project types after 2012 (Article 11a, paragraph 9).

[3] This is achieved through discounting: companies choosing to comply through international offsets need to reduce 1.25 tons of emissions for each ton they offset. In other words, there is a discount rate of 20% (Olander and Galik, 2009).

[4] Although programmatic CDM could help improve the sectoral distribution of CDM (Schneider, 2008), it is beyond the scope of this article, as it does not explicitly differentiate among project types.

host certain project types (UNFCCC, 2008b). Discounting/multiplication could also be implemented simultaneously for both countries and project types. For example, industrial gas projects from different countries or country groups could be discounted at different rates (Schatz, 2008). In general, the benefits of such combinations will have to be weighed against the increased complexity that they entail.

Implementing differentiation at the international level would further require the development of a set of rules that govern the transition to the differentiated scheme. Most likely, differentiation would apply only to new projects; to ensure legal certainty, the CDM Executive Board has for the most part avoided the retroactive imposition of rules on existing projects.

4. Carbon markets impacts of differentiation options

The impacts of various differentiation options on the carbon market are an important consideration when deciding on their implementation. This section analyses the possible impacts of differentiation on the carbon credit supply potential in quantitative terms. For this purpose the marginal abatement cost (MAC) curve for greenhouse gas emission reductions in non-Annex I countries developed by the Energy research Centre of the Netherlands (ECN) is used. A description of the ECN MAC and its caveats can be found in Annex A. This section examines several of the differentiation options introduced in Section 3, first for differentiation between countries, then between project types. The operationalisation of the various differentiation options for modelling purposes in this article should be regarded as illustrative rather than policy prescriptive.

For differentiation between countries, this article categorises host countries according to two criteria: 'capability' (income per capita) and 'responsibility' (CO_2 emissions per capita in 2004; see Gupta, 2003). Income thresholds are derived from the World Bank (2008) classification that distinguishes between low income (US$935 or less); lower middle income (between US$936 and $3,705); upper middle income (between US$3,706 and $11,455); and high income ($11,456 or more). For greenhouse gas or CO_2 emissions, there is no standard classification of 'low', 'medium', or 'high' emissions. Instead, this article uses an illustrative classification of countries according to two thresholds, the first one corresponding to the highest emissions by an LDC (Yemen; 1t); and the second corresponding to the global average per capita CO_2 emissions (excluding land use, land use change and forestry) in 2004 (Bakker et al., 2009). In order to illustrate this, Figure 1 shows in which categories 20 randomly chosen non-Annex I countries fall, using figures from World Bank (2008) for gross national income (GNI) and WRI (2007) for CO_2 emissions per capita in 2004.

<insert Figure 1>

Following this example, Figure 2 shows the impact of several differentiation options on credit supply potential in three steps. The curves describe the greenhouse gas emission reduction potential in 2020 (x-axis) that can be achieved at a certain cost level (y-axis). In the first step, several high-income countries, including South Korea, Saudi Arabia, Qatar and Singapore, would no longer be eligible to host CDM projects. This has only a small impact on the supply potential. The next step (thin continuous line) shows what happens to the CER supply potential if CERs are discounted by 25% for countries with lower-higher middle income and medium to high emissions per capita (shaded area in Figure 1).[5] In the case of CER discounting, the x-axis represents (millions of) CERs rather than tonnes of greenhouse gas emission reductions: the emission reduction potential does not change, but the number of CERs generated does. This option reduces the CER supply potential significantly (19% fewer credits at a CER price up to $25), as these countries account for a major part of the emission reduction potential. In the final step (dotted line) the greenhouse gas emission reductions from projects in LDC/SIDS are multiplied by a factor of 1.5 when issuing CERs. The supply potential increases by a small but not insignificant amount (9% at $25/CER).

<insert Figure 2>

With respect to differentiation between project types, the impacts of a 'negative list' approach to differentiation are examined first on the basis of the supposedly low sustainable development benefits, high windfall profits and technical difficulties with baseline determination and additionality for certain project types. The first scenario investigates the impacts of (continued) exclusion[6] of CO_2 capture and storage (CCS) projects, exclusion of HFC-23 from HCFC-22 production and industrial N_2O destruction on the total available abatement potential[7]. The implications of leaving CO_2 capture and storage outside of the scope of the CDM are assessed next (third line from the right). In both cases, the changes compared to the baseline case are relatively minor (2% and 3% at $25/CER respectively). Under the final scenario only renewable energy (RE) and energy efficiency (EE) projects are eligible under the CDM, based on their relatively high sustainable development benefits.

[5] Supply-side CER multiplication or discounting (i.e. multiplication by a factor smaller than 1) has an impact on both the potential and cost of generating CERs from implementing projects, even though the cost and potential for achieving greenhouse gas reduction will not change. If discounting was applied on the demand side, the effects would be different (Schneider, 2009).

[6] As of March 2010 CCS is not eligible as a project activity under the CDM, therefore this scenario describes the current situation. However its inclusion is being negotiated in the UNFCCC discussion on the future of CDM.

[7] Registered CDM projects involving HFC-23 and N_2O destruction have been excluded from the abatement potential.

Although the remaining potential is significantly lower than the baseline case (43% at $25/CER), there would be substantial low-cost potential also in this case. However, a large part of this potential comes from the transport and buildings sectors (see also Metz et al., 2007), which has proven difficult to harness in the past, particularly under the CDM.

<Insert Figure 3>

The above examples of CDM differentiation show that some options may have significant impact on the potential supply of CERs. However, considering a projected demand in 2020 of 0.5–1.7 Gt CO_2/yr (UNFCCC, 2008c), sufficient potential would remain, resulting in limited impacts on the carbon market. Below we discuss a few key findings, starting with differentiation through discounting. Applying a discount factor of 25% for middle income/medium-high emission per capita countries (i.e. most advanced developing countries) would leave enough potential to meet high CER demand scenarios.

Applying multiplication factors greater than 1 may endanger the environmental integrity of the CDM, as this could create more CERs than emission reductions (UNFCCC, 2008b). Therefore, when considering multiplication factors it may be necessary to use these in such a fashion that the total potential for CERs is not larger than the greenhouse gas emission reductions from potential CDM projects. If the additional CERs this may create are compensated for by CER discounting for other countries or project types the environmental integrity of CDM could be maintained. However, this may be difficult in practice, as the development of the project pipeline cannot be predicted. A relevant question therefore is whether increasing the relative attractiveness of certain projects by CER multiplication – an effect that could achieved through discounting alone – is worth the environmental risk.

As more projects originate from medium- to high-income countries (Bakker et al., 2009), discounting these could still lead to an overall net reduction in greenhouse gas emissions through the CDM, when multiplication for low-income countries is applied. The potential for RE/EE projects is significantly higher than that for high industrial HFC/N_2O gases, thereby making it difficult to compensate for possible multiplication: it could lead to more CERs than emission reductions achieved. With regard to Party eligibility and negative lists, we have shown that exclusion of host countries or project types could reduce the overall cost-effectiveness of the system by reducing the total number of projects available in the market. However, the exclusion of high-income countries has only a limited effect on the global carbon market.

5. Implications for CDM governance

All options for CDM differentiation inevitably have implications for CDM governance and for the various actors involved in the CDM project cycle, including the CDM Executive Board and the UNFCCC Secretariat, the designated operational entities (DOEs) responsible for the validation and verification of CDM projects, as well as project developers.

Some options would initially increase the workload of the CDM Executive Board, which would need to develop or adjust the relevant modalities and procedures. Accounting for sustainable development benefits, if they were to be determined at the international level, would arguably result in the heaviest increase in workload and complexity (depending on how much of the review duties are administered by operational entities). By contrast, other options, such as differentiated eligibility, a positive list, discounting and quotas would eventually only have minor implications, especially when compared to the Board's current workload, which already involves assessing hundreds of CDM projects, methodologies and issuance requests per year.

The role of the UNFCCC Secretariat and its CDM division, which operates as the analytical and administrative back-up of the CDM Executive Board and its subordinate bodies (Netto and Schmidt, 2005), would be especially critical in ensuring transparency (e.g. through a web interface) in the administration of all options that incorporate a dynamic element, i.e. where the eligibility status of countries or project types is subject to change over time. Furthermore, quota requirements and discounting/multiplication schemes may require adjustments of the international registries, registry regulations and the international transaction log (ITL) in order to identify the different types of CERs that would result from the introduction of a supply or demand quota, for instance.

Moving to the implications for host country Designated National Authorities (DNAs), the differentiation option that would have the most impact on their operations is undoubtedly the setting of an internationally determined requirement for sustainable development benefits – provided Parties could agree on this controversial matter in the first place – as it would take away their exclusive competence in assessing this matter. However, this is theoretically not easy – since sustainable development is context-relevant and there are no one-size-fits-all criteria. Nevertheless, generic schemes can be developed that are also open for DNAs to provide their own interpretation.

Looking across all differentiation options, DOEs, which are responsible for the independent validation and verification of CDM projects would, in all likelihood, also be most affected by

the adoption of minimum standards for sustainable development benefits. Adopting this approach would complicate their tasks at the validation stage, by extending their review responsibility to incorporate not only the first objective of the CDM – emission reductions – but also the second, their contribution of sustainable development, which is less tangible and arguably much more difficult to ascertain, and has been left to the judgement of the host countries under the current rules. Other options would have a more limited impact.

Turning to the implications of CDM differentiation for project developers, some forms of preferential treatment for certain countries or project types (e.g. fast-tracking or simplified modalities and procedures; and financial or capacity building support) would effectively improve their situation in either financial or process terms. However, other options rather complicate the CDM development and approval process from the developers' perspective, or make projects less attractive or risky. This mainly relates to increased regulatory uncertainty resulting from the incorporation of more dynamic elements (graduation of countries, discounting factors or quota requirements) into the CDM. Project risks stemming from regulatory uncertainty are already now inherent part of the CDM business, but would increase significantly with more complex differentiation models.

Finally, there might be issues related to the fungibility of CERs. Some of the options for differentiation by countries or project types – notably quota requirements – would *de facto* create different commodities, depending on the origin of the CERs or the project type from which they originated (e.g. LDC-CERs and non-LDC-CERs). As discussed above, the serial numbers of CERs in the registry could identify the different types of CERs. As a consequence, CERs would also have a different market value and be traded at different prices, *a priori* an effect intended by differentiation. However, this would also result in reduced fungibility of certificates, i.e. it would create a degree of fragmentation in the carbon market. Other differentiation options (e.g. discounting of credits, (in)eligibility to host projects) would not produce this effect, and as a consequence may be seen as less prone to market fragmentation.

6. Can differentiation in the CDM address the concerns?

The various differentiation options are based on different rationales. Yet all will need to be evaluated against the extent to which they succeed in addressing key concerns about the current functioning of the CDM discussed in Section 2: the environmental effectiveness of the mechanism (including additionality and whether the system moves beyond offsetting); the projects' contribution to sustainable development; regional and sectoral distribution of projects; and concerns about high windfall profits. Since little or no (quantitative) information

is available for most of the options and since their specific design remains unclear (e.g. discounting of CERs by a factor of 0.2 would have a larger impact than a factor of 0.8), our assessment is necessarily preliminary and the conclusions drawn tentative.

Looking first at the question of *environmental effectiveness*, this concern, coupled with the objective of moving the CDM 'beyond offsetting' to achieve net greenhouse gas reductions, is at the core of proposals for CER discounting schemes. In addition, discounting may also be a way to deal with inherent uncertainty in establishing baselines and additionality. Therefore, this option has significant potential to increase the environmental effectiveness of the CDM (Schneider, 2009). If CER issuance caps or (in)eligibility to host projects in certain host countries were coupled with an incentive for these countries to provide their own contribution to climate change mitigation (beyond the CDM's offsetting approach), this would also result in emission reduction benefits. As to differentiation between project types, negative lists or issuance caps for certain project types could provide disincentives to projects with questionable additionality or difficulties in emission accounting, thus contributing to the environmental integrity of the mechanism. In contrast, a positive list approach (i.e. automatic additionality for certain project types or host countries) or specific incentives for projects with high sustainable development benefits could reduce the environmental integrity of the CDM if they result in an increase in non-additional projects.

The option that most directly addresses the *contribution of the CDM to sustainable development* in the host countries is the establishment of a minimum threshold for sustainable development benefits. However, given the strong opposition of developing countries to international standards or assessment when the matter was initially discussed at the Conference of the Parties in Marrakech in 2001, the political feasibility of this option will only improve when criteria open to DNA interpretation are allowed. For the other options, their potential to enhance the CDM's sustainable development benefits depends on the extent to which project types or (groups of) countries can be associated with higher quality projects. In terms of project types, one interpretation that finds some support in the literature (Sutter and Parreño, 2007; Holm Olsen and Fenhann, 2008) is that large-scale industrial gas projects (i.e. HFC-23 and N_2O) produce fewer sustainable development benefits. Thus, options restricting the market share of these projects, through a negative list or allocated demand requirement, would potentially strengthen the sustainable development benefits of the CDM as a whole. For other project types, the conclusion is less straightforward. For example, the commonly held view that renewable energy projects in general contribute more to sustainable development (e.g. Pearson, 2005) has been nuanced by Holm Olsen and Fenhann (2008), who argue that this is not the case for all types of renewables. As to differentiation between

countries, one might argue that projects implemented in LDCs or SIDS contribute more to sustainable development than projects in other countries (e.g. Cosbey et al., 2006). If this could be ascertained empirically, options that steer investments towards these countries, such as the ineligibility of other countries to participate in the CDM, allocated demand, or the multiplication of credits from projects implemented in LDCs and SIDS, could potentially be seen as improving the CDM's contribution to sustainable development. Caps on issuance, however, may lead to lower quality CDM projects, "because project developers may be forced to cut corners in the face of increased costs caused by exhausted country quotas in countries where project implementation is cheaper" (Silayan, 2005: 53; see also Banuri and Gupta, 2000).

Moving on to the concerns about the *regional distribution* of CDM projects, this is certainly a key objective of differentiation between countries, such as the option of allocated demand, which requires a minimum amount of CERs to be purchased from certain host countries. Eligibility differentiation also holds potential to change the regional distribution, as excluding some countries from the CDM may leave a greater market share for others. However, a redirection of investment flows is not guaranteed – the market may also shrink (Murphy et al., 2008). The same holds for discounting or multiplication of CERs, which may improve conditions for currently underrepresented countries, but on its own is unlikely to result in more than a marginal improvement in the competitiveness of LDCs (Castro and Michaelowa, 2009). In the same vein, preferential treatment, such as the options for underrepresented sectors and countries that were recently adopted (UNFCCC, 2009d), will hardly have a large impact on regional distribution. Depending on which project types are distinguished and what the future mitigation potential is in different countries, differentiation by project type could indirectly influence regional distribution. For instance, the inclusion of avoided deforestation may increase the potential for LDCs (although local governance challenges in LDCs may still affect their ability to attract projects), whereas the exclusion of HFCs could to some extent improve the regional balance, as most of these projects are now implemented in only a few countries. Similarly, if a positive list approach (i.e. automatic additionality for certain project types) were implemented and small-scale (renewable energy) projects were on such a list, the regional balance of CDM projects might improve as these projects are arguably more implemented in LDCs, at least in relative terms. The same holds for multiplication or discounting of CERs, assuming that the discount rates would favour small-scale projects.

Improving the *sectoral distribution* of CDM projects towards sectors that have been underrepresented in the CDM to date (such as the transport, buildings, agriculture and forestry sectors) can only be achieved effectively by allocating a portion of demand to these sectors.

Other options, including discounting/multiplication, caps on issuance, positive/negative lists for certain project types, or minimum sustainable development thresholds – together with the further development of programmatic CDM – may improve the conditions for these sectors slightly compared to the other sectors. However, their impact on sectoral distribution is not likely to be large. CDM projects in the energy supply and industry sectors would probably remain attractive, as they would hardly be included in a negative list. Some authors have noted that the CDM in its current form, regardless of possible differentiation, is simply not well-suited for certain project types (e.g. Sterk, 2008).

Finally, *windfall profits* for low cost projects can be reduced most directly by excluding the relevant project types from the CDM or by setting caps on credit issuance. Furthermore, discounting these project types by a factor that reflects the marginal abatement costs compared to CER prices (Schatz, 2008) might reduce the amount of windfall profits, even though this effect could to some extent be offset by CER price increases resulting from scarcer credit supply as a consequence of discounting. Allowing only projects with high sustainable development benefits would probably mean the end for the project types in question, too. However, windfall profits may increase for other projects due to a possible rise in CER price if the credit supply is less abundant.

7. Conclusions

CDM reform is one of a number of issues currently on the negotiation table in the discussions on post-2012 climate policy. In order to address concerns about the current functioning of the CDM, several differentiation options under the mechanism have been suggested as a possible way forward. This article provides a first analysis of how differentiation between countries and project types could be implemented in practice, looking in particular at their impact on the carbon market as well as their implications for different actors in the CDM. The question of whether and how to differentiate within the CDM is clearly embedded in the broader debate on the role of flexibility mechanisms in future mitigation efforts and the shape and form of a future climate regime. This includes extending the role of market-based mechanisms to incorporate sectoral approaches, the crediting of nationally appropriate mitigation actions in non-Annex I Parties and the overall architecture of a post-2012 agreement. However, it is likely that CDM will continue to play a significant role, particularly in the near future, given the uncertainty regarding the future mechanisms, and the time needed to agree on specific rules and procedures for new mechanisms.

Our key findings are as follows. First of all, *preferential treatment* for underrepresented host countries or preferable project types appears to be an option without significant negative

impacts, but its contribution to improved regional distribution and sustainable development is likely to be limited. Still, given that there is precedent for such treatment, notably for LDCs, host countries with fewer than 10 registered projects, and small-scale projects, these options would most likely be politically feasible; although actual project development and implementation at ground level may be difficult. It can therefore be considered a 'no-lose' option, which is insufficient to significantly change the current sectoral and regional distribution, but could still provide modest support to some countries and project types bypassed by the CDM so far at little political cost.

Second, *minimum thresholds for sustainable development* set at the international level, and verified by DOEs, may improve the sustainable development profile of the CDM project portfolio. However, quantifying sustainable development benefits has been shown to be problematic, while standards will likely increase the transaction costs associated with the CDM project cycle. In addition, it would be very difficult to define sustainable standards at the international level, since they would have to fit specific circumstances and development priorities of individual host countries.

Third, differentiation based on *quotas or eligibility of countries or project types* could significantly change the regional distribution of CDM projects. The supply of credits would likely be reduced under these options, but would be sufficient to meet most 2020 demand scenarios. However these options, and in particular differentiation between country eligibility, are likely to be difficult to agree on in negotiations, given traditional political sensitivities about differentiation between non-Annex I countries in the context of the climate negotiations. However, in the run up to Copenhagen, the reluctance of the United States to take on any commitments without developing countries adopting some kind of voluntary targets has led to a trend-break. Many of the large developing countries have shown themselves willing to adopt unilateral, voluntary targets; thereby showing a willingness to consider a new role in the future.

Finally, *CER discounting* can contribute positively to most of the issues, in particular by creating a mechanism that results in net global greenhouse gas emission reductions (if the discount rates are higher than the share of non-additional projects being registered in the system). Also the discount rates can be applied and adjusted so that they benefit underrepresented countries in the CDM market benefit or project types with particularly strong contributions to sustainable development (if they can be identified). Discounting of appropriate project types may equally reduce windfall profits. The most important drawback is that it is likely to be difficult to negotiate the discount rates. On the market side, the option

will have an impact on both the abatement cost and potential of mitigation options. Global supply of credits is likely to suffice to meet the projected demand for the discount factors applied in the illustrative analysis in this article (i.e. 25% CER discounting for medium income / medium-high emissions per capita countries; 50% for industrial HFC-23 and N_2O). CER multiplication by factors greater than 1 could be considered for a limited number of underrepresented countries or technologies, and in combination with discounting in order to limit the risk of undermining the environmental integrity of the CDM.

Overall, it can be concluded that there are clear trade-offs: the options that seem the easiest to agree on have the smallest negative impact on the CDM's functioning as a market mechanism, but also the smallest positive impact on sustainable development and the geographical distribution of projects. In that regard, the various ways of preferential treatment are likely the easiest to implement. To find a balance between the CDM's different objectives, the middle-of-the-road options could be explored in more detail. In addition, discounting could be explored, as it is an option which could be introduced gradually. The most challenging option may be the explicit exclusion of countries from participation in the CDM, although it would address the geographical imbalance most directly. Differentiation between project types could be more straightforward than differentiation between Parties. If differentiation between Parties could be agreed upon in the broader framework of a new climate agreement, i.e. not related to the flexible mechanisms specifically, then it may be sensible to extend the same country classification to the CDM. If it proves difficult to agree internationally on differentiation, some options may also be implemented unilaterally by countries or regions. Considering the example of the EU, which takes the largest share of the CER demand currently, this can be an effective approach. Notably, the use of a minimum threshold for sustainable development benefits, or allocating demand to specific countries or project types do not necessarily require an international approach.

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Annex. Description of the ECN non-Annex I MAC

The marginal abatement cost (MAC) curve of the Energy research Centre of the Netherlands (ECN) is based on earlier ECN studies using bottom-up assessments of mitigation potential in developing countries (Wetzelaer et al., 2006; Bakker et al., 2007). It includes all major sectors, greenhouse gases and technologies. For the CO_2 reduction options, the main data sources are detailed country abatement studies carried out between 1998 and 2006. Some of these studies only report the reduction potential for 2010. This was extrapolated to 2020 by applying a general growth factor for CO_2 emissions by world region based on the World Energy Outlook 2007 (IEA/OECD, 2007). For some countries (representing approximately 20% of the greenhouse gas emissions non-Annex I countries), no detailed bottom up study could be found. For afforestation and reforestation, Bakker et al. (2007) used an approach related to the potential for forest conservation. Inclusion of non-CO_2 options in the MACs has mostly been performed by using data from an extensive study carried out by the US Environmental Protection Agency (USEPA, 2006). In addition bottom-up estimates of CCS in power and industry as well as (afforestation, reforestation and avoided deforestation) were added. In a recent update (Bakker et al., 2009) additional data for CCS in natural gas processing, mitigation options in sub-Saharan Africa, and additional estimates for renewable energy and energy efficiency potentials for advanced developing countries were included. All abatement cost figures were expressed in US$ of 2006 price levels.

Some limitations of the approach of collecting bottom-up greenhouse gas abatement data from a range of sources to compile MAC curves for the non-Annex I region should be noted. First, the cost studies may not have covered all possible mitigation technologies[8]: in particular the potentials for the buildings sector and renewables such as biomass, wind, hydro and geothermal are likely to be underestimated. McKinsey & Company (2009) estimates a potential of 13 Gt CO_2-eq/yr in 2020 for non-Annex I countries (using higher baseline emissions than those in the ECN MAC). Therefore, even though the database underlying the MAC curves has been updated on several occasions, it cannot be considered as an exhaustive overview of mitigation options. This is especially true for renewable energy potentials and has strong implications for the total identified reduction potential. For example, for China the total identified potential is 1.8 Gt CO_2-eq/yr, which is significantly lower than some other recent studies (e.g Höhne et al., 2008).

Second, the baseline emissions against which the reduction potentials were estimated were reported on a sectoral basis, or sometimes not at all. The assumed baseline largely determines

[8] Halsnæs et al. (1998) note that such country studies are not aimed at covering an exhaustive list of options.

the reduction potential, and may also change significantly over the years due to updated insights related to e.g. economic growth. The difference in potential for China, referred to above, may be explained to a great extent by diverging baselines across the different studies.

Third, different assumptions and approaches across abatement costing studies make it difficult to reconcile and combine results. In calculating greenhouse gas reduction potential and costs, studies make different assumptions about important parameters such as discount rates, fuel prices, global warming potentials, technology characteristics, etc. These assumptions strongly affect the calculated greenhouse gas savings potential and cost. The definition of costs was not consistent across studies. In general, the abatement costing studies attempted to calculate the incremental costs of abatement options, but they used different definitions of what is incremental. Economic benefits were excluded in some instances and apparently double-counted in others. Several studies noted that the cost calculations were preliminary, uncertain or qualitative.

Finally, it needs to be considered that the bottom-up abatement cost studies are from 1998 to 2006. Oil prices assumed in the studies were in the range of US$ 20-40 per barrel, which is significantly lower than the most recent projections in the World Energy Outlook 2007 (US$ 62 in 2030 (IEA/OECD, 2007)).

We also note that the economic greenhouse gas abatement cost curves do not include non-financial barriers related to technology deployment or CDM regulations related to additionality. If these were taken into account, a 'market potential' for CDM projects would be obtained, which could be substantially lower than the economic greenhouse gas reduction potential (Bakker et al., 2007).

For the purpose of this article – analysing the impact of CDM differentiation options – the MAC can be deemed suitable. An advantage compared to other models is the level of technical detail: it includes over 1000 country-technology combinations. In the following analysis on CDM differentiation options, we will use the curve of the CDM eligible technologies plus CCS and avoided deforestation. Nuclear energy, however, has not been included.

Tables and figures

Table 1 Overview of CDM differentiation options

Differentiation option	Explanation	References
Countries		
Eligibility to host projects or to buy CERs	Certain non-Annex B Parties are excluded from hosting CDM projects; or certain Annex B Parties are excluded from buying CERs.	UNFCCC, 2009a; 2008b
Discounting/ multiplication	The number of CERs issued equals less or more than the achieved greenhouse gas emission reductions. Different discounting/ multiplication factors may be introduced for projects from different (groups of) host countries. Discounting may also be applied on the demand side, in which case a portion of the purchased CERs is retired rather than used for compliance.	Schneider, 2009; UNFCCC, 2009a; Chung, 2007
Preferential treatment	Several forms are possible, including: 1) exemption or a more relaxed application of additionality test for some host countries or country groups; 2) dedicated funds for capacity building or project development; 3) fast tracking projects by simplifying project cycle requirements; and 4) reimbursement or upfront payment of project cycle transaction costs through by UNFCCC.	UNFCCC, 2008b; 2009
Cap on issuance	Limitation of the amount of CERs that can be issued from projects implemented in a particular host country. When this cap is reached the country becomes ineligible to host further projects.	Banuri and Gupta, 2000
Allocated demand	When using CERs for compliance purposes, Annex B countries must demonstrate that a minimum portion of these CERs originates from certain host countries or country groups.	UNFCCC, 2008b
Project types		
Positive list	Project types on a positive list are deemed automatically additional and thus exempted from additionality testing.	UNFCCC, 2009a
Negative list	Certain project type(s) are excluded from the CDM.	Wara, 2007
Discounting/ multiplication	The number of CERs issued equal less or more than the achieved GHG reduction. Different discounting or multiplication factors may be introduced for different project types. Using ambitious benchmarks may also be part of this, e.g. by setting emission standards per unit of product below business-as-usual.	Chung, 2007; Schneider, 2009
Minimum threshold for sustainable development benefits	Projects need to quantify and demonstrate their sustainable development benefits to be eligible. The sustainability standards could be set at the national or international level, and evaluated by validators and/or the CDM Executive Board.	UNFCCC, 2009a
Preferential treatment	For certain project types, there could be a more relaxed application of the additionality test, funding for capacity-building or project development, or increased/decreased taxes/levies.	Cosbey et al., 2006
Cap on issuance	Introduction of a cap indicating the maximum amount of CERs that can be issued from certain project types.	UNFCCC, 2009a
Allocated demand	Annex B countries must purchase a minimum portion of CERs from particular project types, e.g. as a share of total CERs used for compliance.	UNFCCC, 2009a; Schneider, 2008

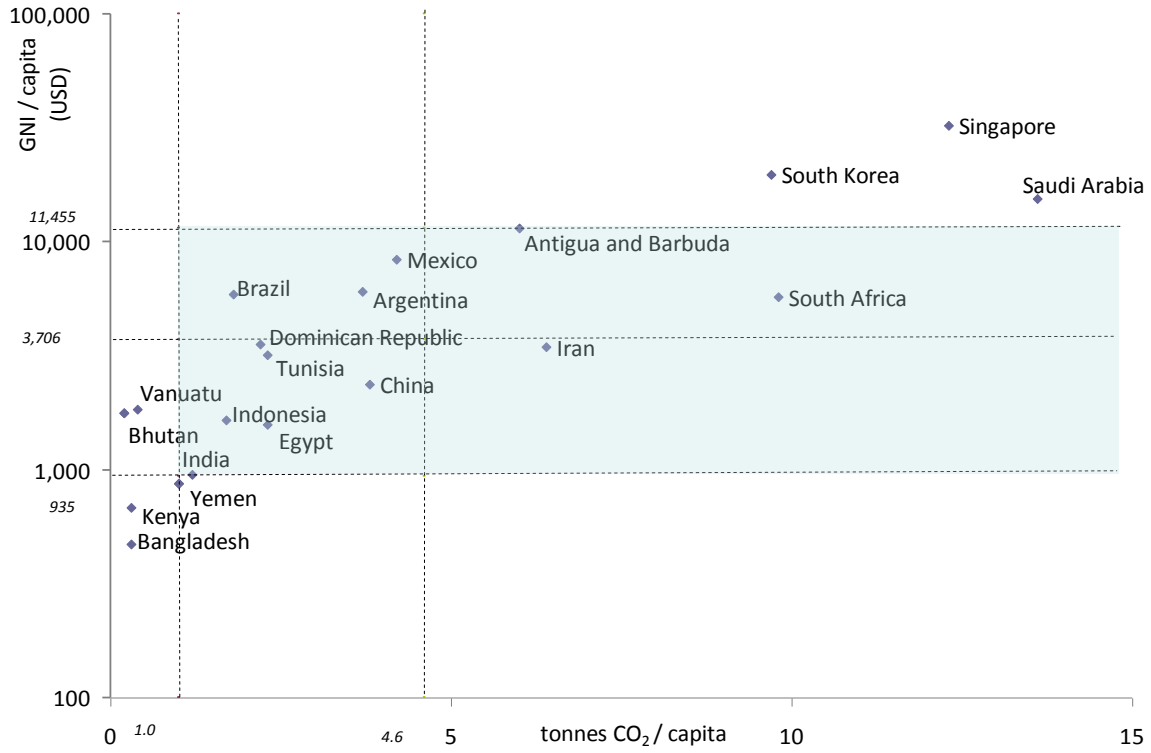

Figure 1. Illustration of country classification for 20 non-Annex I countries.

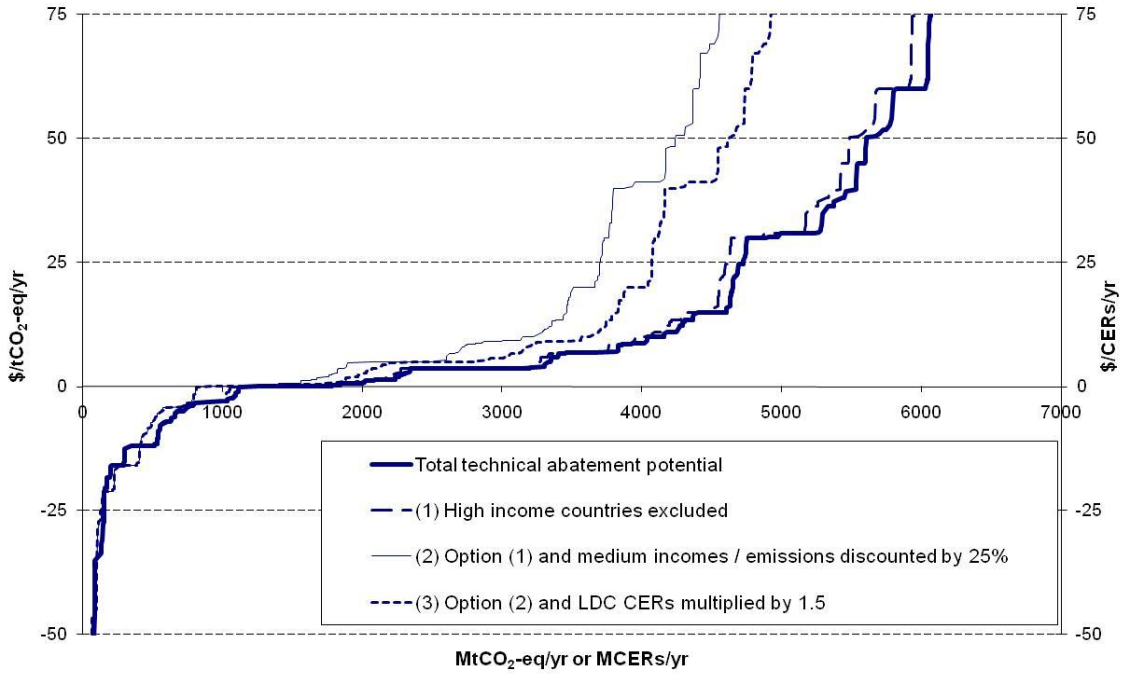

Figure 2. Discounting and multiplication of CERs to show the effects of differentiation between countries. Discounting by 25% means that reductions with a marginal cost of $10 only become attractive at $13 and receive CERs for 75% of the emission reductions achieved. This shifts the cost curve upwards and to the left.

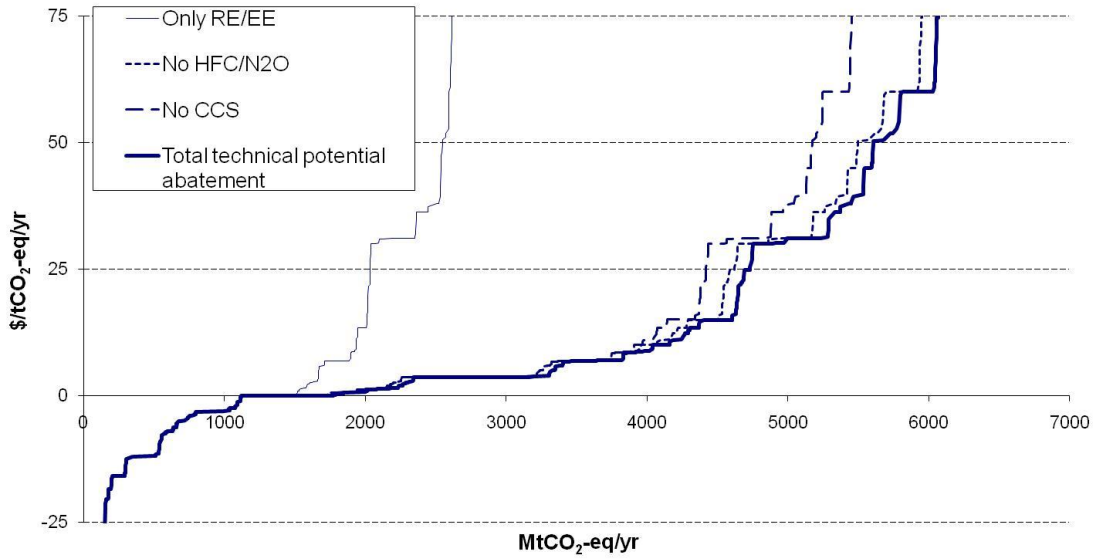

Figure 3. Impact of technology eligibility scenarios.